

Recent Modifications to the DSN Monitor and Control System

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Recent improvements to the monitor function of the DSN Monitor and Control System are described in this article. The changes include the use of a new Digital Instrumentation Subsystem computer program that will serve as a single monitor program for all deep space stations. The effects of the new or modified equipment on activities of operations personnel are also discussed.

I. Introduction

This article describes recent improvements made to the monitor function of the DSN Monitor and Control System. Tests of the new or modified features thus far have been successful, but more extensive testing is planned before the modified system is considered fully operational. The expected operational date is July 1, 1973. Usage of the modified system will affect the Network Control System and the Model 8 software at the Network Operations Control Area.

II. Single DIS Program To Be Used by All Deep Space Stations

In the past, there have been as many as three different Digital Instrumentation Subsystem (DIS) software programs operating simultaneously at the different deep space stations (DSSs) (DOI-5022-OP, DOI-5029-OP, DOI-5038-OP). Use of a particular program was dependent

upon the project supported and the DSS equipment complement. With these different software programs, considerable difficulty was encountered by operations personnel in determining whether the parameter displayed was a legitimate one. The net result was a delay in the analysis of data.

The new program (DOI-5046-OP) is designed to be mission- and station-independent, i.e., to serve as a single monitor program for all DSSs. The major changes related to the new program are as follows:

- (1) X-band radio metric data have been added at DSS 14.
- (2) Block IV receiver parameters will be processed at DSS 14.
- (3) Displayable parameters can be reviewed and updated.
- (4) A second cathode-ray tube (CRT) has been added at DSSs 14, 43, and 63.

- (5) The input/output (I/O) printer at the station monitor console (SMC) has been replaced with a medium-speed character printer.

The program is such that expanded capabilities within the DSN can be easily accommodated by the software, especially in the high-speed data (HSD) output. The HSD output is in three parts: DSS initialization/accountability HSD blocks, DSS status HSD blocks, and DSS configuration HSD blocks. Table 1 shows a subset of the actual parameters that are monitored in each block. The format of each block is designed so that the unused words and bits are, if possible, lumped together in one location. This provides space for expanded DSN capability and a time saving and improved reliability in the analysis of the contents of the monitor data output.

Operationally, the single program provides many advantages to the users of DSN data, including:

- (1) The operations analyst can develop one set of algorithms for network analysis.
- (2) Operations personnel training can be significantly reduced, with better overall results.
- (3) DSN data users can better understand the network data without taking into consideration the differences in the stations' equipment complements.
- (4) The location of parameters within the HSD blocks will be the same from station to station; therefore, a data mask can be more easily designed to display desired data.

III. Parameters From New Equipment

Each time new equipment has been installed at a station, the software has changed significantly to accommodate the new equipment. The current DIS software is modular-designed; this allows software revision with minimum redesign and programming effort.

At DSS 14, a Block IV receiver will be added along with X-band radio metric data in the Tracking Data Handling (TDH) Subsystem. The DSN Monitor System will display the status and configuration of these new subsystems.

At the co-located stations (DSSs 42/43 and 61/63), there is a time switching matrix (TSM) and a command complex switching (CCS) matrix. These matrices are for the shared equipment.

The TSM is used to determine the time mode of the Complex and the data decoding assembly (DDA)/telemetry command processor 2 (TCP2). The time modes are real time, tape time, or simulated time. In other words, the complex can be on real time while the DDA and TCP2 are on tape time, or all can be on real time or simulated time. The configuration of the Complex is displayed via the Monitor System. For the Complex, there is only one TSM. The DIS from each DSS in the Complex will send the status to its corresponding SMC to be displayed on a CRT and the medium-speed character printer with a time tag.

The co-located stations share three command modulator assemblies (CMAs). Each CMA can be in either the selected mode, the standby mode, or the not-used mode. One CMA is always used as a spare. The CCS is used to determine the configuration of the CMAs. The configurations of the CMAs will be available at both DISs, and each DIS will send the status to its corresponding SMC to be displayed on a CRT. In addition, each DIS will send the message plus a time tag to the medium-speed character printer (MSCP).

To facilitate operations at the co-located 26-/64-meter stations (DSSs 42/43 and 61/63), a "SMC Junior" has been installed in the data area to allow those personnel operating shared equipment visibility into the status of the overall tracking operations. The SMC Junior contains two CRT units, one for each of the co-located stations (Fig. 1). These units are identical to the unit in the main SMC. The displays are under the control of the respective SMC keyboard units. A time display and various equipment configuration select indicators are also available on the SMC Junior.

IV. S/X-Band Radio Metric Data Output via DIS High-Speed Data Line

Four block types of data, distinguished by content and frequency of transmission, are transmitted from the DSSs via the DIS high-speed data line (HSDL).

- (1) S-band radio metric data (10 samples/block).
- (2) X-band radio metric data (10 samples/block).
- (3) S-band radio metric data at a TDH-selected low rate (4 samples/block).
- (4) X-band radio metric data at a TDH-selected low rate (4 samples/block).

S-band doppler and X-band doppler are sampled synchronously. However, S-band doppler data are output by the DIS as a separate data block. There is sufficient configuration data in each data block to determine if it is S-band or X-band and whether it is from the operational Block III receiver and ranging equipment or the experimental Block IV receiver and research and development ranging equipment.

V. Display Device Upgrade

To improve timeliness and visibility and to enhance the response time of operations personnel, equipment additions and modifications have been made at the DSSs, particularly in the area of the SMC.

The teletype low-speed printer, previously located near the SMC to display DIS and TCP events and alarms, has been replaced with a MSCP capable of 250-character/second output. This printer will furnish operations personnel with a hard copy of time-tagged events, alarms, and configuration and status information. Up to 15 output messages can be buffered, precluding loss of information during high-activity periods. Control of the printer is exercised via the SMC keyboard unit.

A second color digital TV unit (referred to as a CRT) has been installed in the SMCs at the 64-meter-antenna stations (DSSs 14, 43, and 63) to give operations personnel at these more complex stations additional visibility into the status of the larger variety of equipment utilized. Display formats and parameters may be assigned, modified, or deleted, as with the original CRT unit, by simple entries made at the SMC keyboard.

VI. Parameter Display Selection

In previous versions of the monitor software, many parameters, although included in the output HSD blocks, were not readily available for display to operations personnel. This led, in some cases, to delays in detecting impending or actual problems. The new software has, for the most part, alleviated this condition.

In addition to the parameters added to the system relative to the S/X-band equipment (TCD status, etc.), operations personnel now have readily available for display several items that were previously accessible only by program location callout. Monitor subsystem processor alarms are more detailed, thereby allowing more accurate, timely response by operations personnel. Restrictions as to what type of parameter may be displayed on what device have been removed in most cases. The number of parameters that can be displayed on the high-speed printer at one time has been doubled (from 10 to 20).

A capability to print data transfer information (i.e., HSD input, HSD output, TCP transfer, and TDH input) on the high-speed printer has been added. This feature will greatly facilitate troubleshooting and problem investigation by operations personnel. An additional feature is the capability to perform selected recall and transmission of data recorded in the original data record (ODR) via the HSDL. Selection for recall may be by time period or by HSD block serial number. The ODR now contains the calibration data and predictions used by the system in addition to the output HSD blocks. This feature will greatly facilitate system performance analysis by the Network Control System.

Table 1. HSD blocks and their parameters

DSS initialization/accountability HSD blocks (1 block/60 seconds)	DSS status HSD blocks (1 block/5 seconds) (contd)
<p>Telemetry System configuration (initialization)</p> <ul style="list-style-type: none"> • Receiver, SDA, SSA, BDA, DDA • TCP and channel number in use • Coded/uncoded data • Frame size • Bit rate • % loop bandwidth, channel 1 • Loop bandwidth range and subrange <p>Accountability</p> <ul style="list-style-type: none"> • HSD output and ODR enabled/disabled (TCP) • ODR log write attempts/log write errors (TCP/DDA/DIS) • HSD blocks received/received with errors (TCP) • Command transmission attempts/aborts <p>DSS type – Distinguishes between wing, standard 26-m, standard 64-m, 26-m of co-located, and 64-m of co-located stations to allow processing of only pertinent data fields</p>	<p>Computations (contd)</p> <ul style="list-style-type: none"> • Transmitter power, kW • TCP channel SNR • SSA symbol SNR • DDA, average computations/frame, erasures, frames accumulated • Transmit VCO frequency <p>Accountability</p> <ul style="list-style-type: none"> • HSD input and ODR enabled/disabled (DIS) • HSD blocks received/received with errors (DIS)
DSS status HSD blocks (1 block/5 seconds)	DSS configuration HSD blocks (1 block/60 seconds)
<p>Status</p> <ul style="list-style-type: none"> • Block III and IV receiver lock in/out • SDA, range receiver, range CCTL, synthesizer, lock in/out • Block III and IV transmitter modulation, drive, and beam voltage status • APS normal/fail • Antenna HA rate alarm • TCP/DIS TLM and CMD interface status • TCP TLM string lock status • CMA status/mode • DSS GCF configuration/status <p>Computations</p> <ul style="list-style-type: none"> • Block III and IV receiver AGC, AGC standard deviation, SPE 	<p>Configuration switch/sensor settings</p> <ul style="list-style-type: none"> • APP/APS (doppler mode, doppler DCC, VCO synthesizer lock, sample rate, range/angle quality, program mode, etc.) • SDA (input/output select, input attenuator, symbol rate, bandwidth, lock, etc.) • Antenna servo (drive mode, drive speed/alarms) • Microwave (antenna, polarization, maser, transmitter/load, etc.) • Block III receiver/exciter/ranging <ul style="list-style-type: none"> • Receiver switch settings (RF loop filter, RF loop bandwidth, TLM bandwidth, AGC bandwidth, AGC/MGC, lock, VCO select, doppler extractor, translator, etc.) • Range receiver switch settings (RF loop filter, loop bandwidth, CCTL loop filter, CCTL lock, input select, sync select, etc.) • Exciter switch settings (modulation select/status, beam voltage, transmitter drive, VCO select, synthesizer lock, etc.) • Block IV receiver/exciter/ranging – Essentially the same as the block III receivers with the addition of S/X-band input select

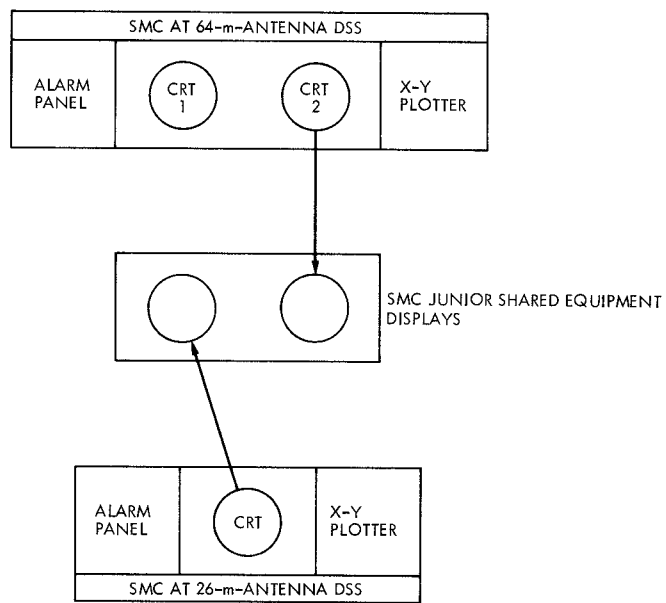


Fig. 1. SMC configuration at co-located DSSs